THE OHIO STATE UNIVERSITY

The Sustainable Columbus Observatory (SCO): Measuring Community Progress Toward Sustainability and Resilience

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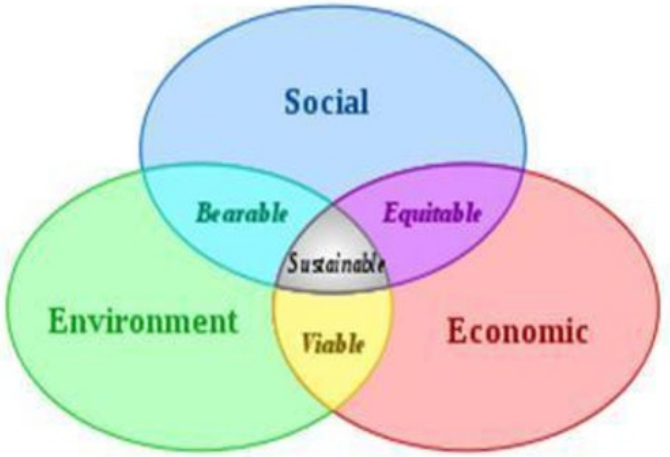
Sustainability policy and planning

Three pillars of sustainability

- **Environmental**: Nature, ecosystems
- **Economic**: Efficiency, growth, performance
- **Social**: Social justice, quality of life, health, well-being



World Commission on Environment and Development (1987), Our Common Future, New York: Oxford University Press.
AKA The Brudtland Report, after its first author, Gro Harlem Brundtland, former prime minister of Norway

Sustainability goals

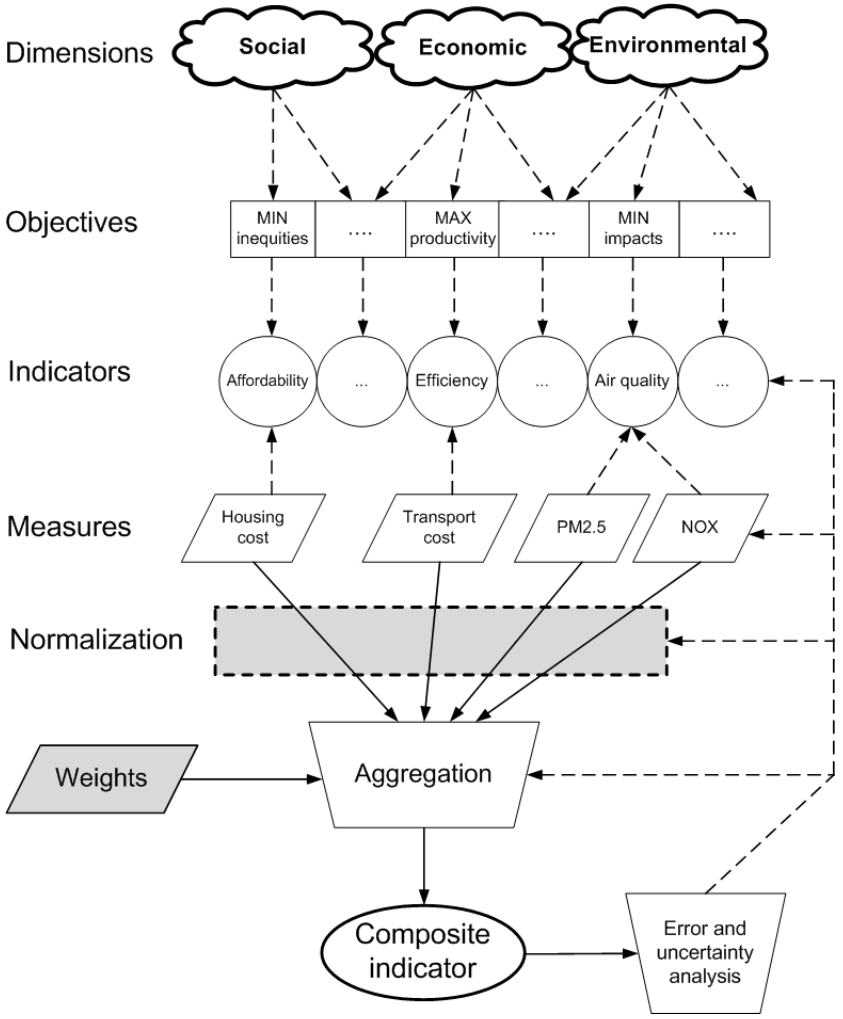
- Normative: What should be done
- Long time horizon: Inter-generational
- Multidimensional
  - Strong Sustainability: **Non-compensatory** – no trade-offs between dimensions
  - Weak Sustainability: **Compensatory** – trade-offs, particularly between natural and human capital

Sustainability policy and planning

Sustainability indicators

A set of measures or a composite measure that track progress towards stated sustainability goals

Must capture interactions among sustainability dimensions



morpc Mid-Ohio Regional Planning Commission

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REGIONAL SUSTAINABILITY AGENDA REPORT CARD

The 2017-2020 Regional Sustainability Agenda is the guiding document for MORPC's sustainability-focused programming and committees, and provides the framework for members and regional partners to work toward common goals. This report card is intended to measure our region's progress in meeting our 2020 targets.

Use the dots above to see more details about each goal.

Visit http://www.morpc.org/sustainability for more information.

http://www.morpc.org/sustainabilityreportcard/

Progress Rating

As a region, we need to devote more resources to this objective.

As a region, we should focus more on this objective.

As a region, we need to keep doing what we're doing.

As a region, we've accomplished what we set out to do but the work continues.

Goal 1: Energy Consumption

1.1 Reduce vehicle miles traveled (VMT).	
1.2 Reduce the percentage of commuters driving alone and increase the percentage of commuters riding transit, biking, or walking.	
1.3 Increase the percentage of vehicles using alternative fuels.	
1.4 Increase the number of trail miles traveled annually.	
1.5 Increase the number of alternative fuel stations.	
1.6 Reduce per capita energy consumption across all sectors.	
1.7 Increase the number of local renewable energy projects and generating capacity.	

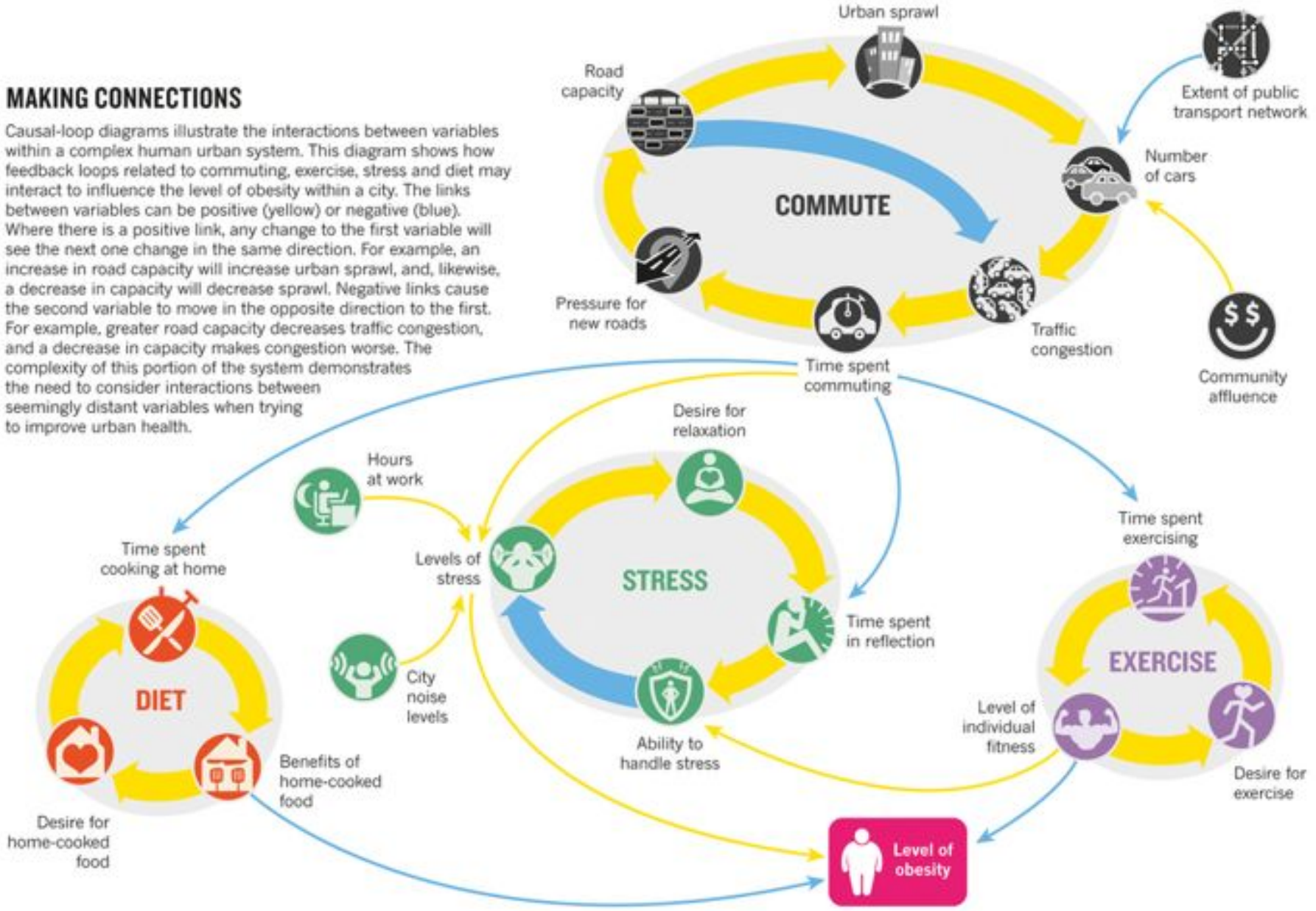
Goal 2: Natural Resources

2.1 Reduce emissions to meet federal air quality standards.	
2.2 Increase the number of people receiving air quality information and education.	
2.3 Reduce the amount of municipal solid waste per capita disposed in the landfill.	
2.4 Minimize greenfield development and promote infill and redevelopment.	
2.5 Reduce per capita water consumption.	
2.6 Improve water quality in the Upper Scioto Watershed.	

Problem: Cities and regions are complex!

"Cities are complicated. They comprise large numbers of people, and the many ecological, cultural, social and economic entities that make up their environment. **All these factors interact in time and space to form complex systems that constantly evolve in response to changes in climate, environment and people**."

Pollock, K. (2016) "Urban physics," Nature, 531, S64–S66 (17 March 2016)



Pollock, K. (2016) “Urban physics,” Nature, 531, S64–S66 (17 March 2016)

How do we use an evidence-based approach to sustainability planning?

- Human and human-environment systems involve **complex feedback loops**
- Outcomes from policy interventions are **non-binary**
- Outcomes playout over **multiple time frames**

Sustainability policy and planning

A possible solution!

Leverage the **persistent data collection** from contemporary **digital and smart infrastructures** to create **data observatories** that enable **opportunistic science**

Observatory science

What?

Ongoing data collection based on a favored view, supported by technology and organizational processes

http://www.brown.edu/

Why?

Discovery: Generate new, surprising hypotheses

Dynamics: Complex multi-scale dynamics

Monitoring and policy: e.g., volcano observatories

Ready when something happens!

Observatory science

Human observatories

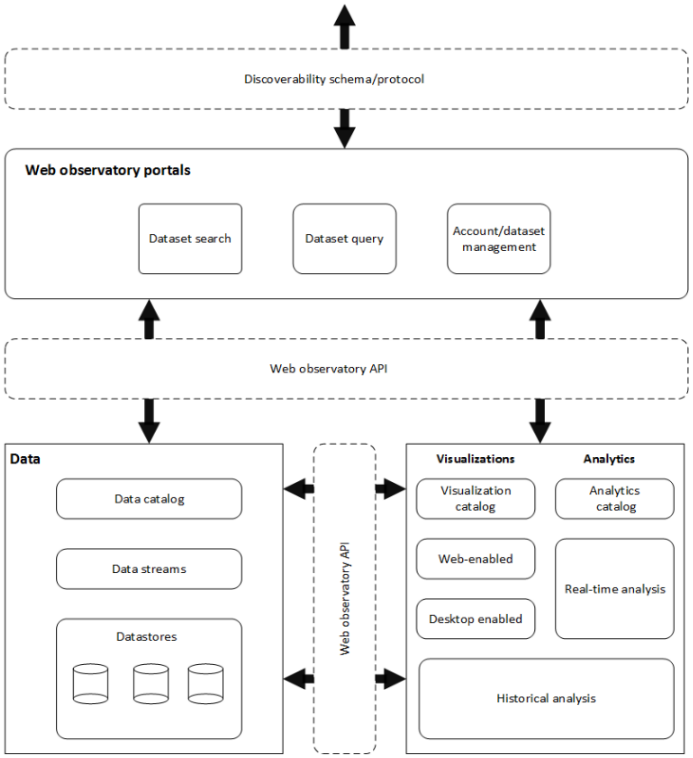
Social observatories

Collect and integrate data about social phenomena
Often focusing on a place or region

Web observatories

Collecting, sharing, querying and analysis of Web data

Middleware for ***broad data*** – complex data from diverse sources



Architecture for a real-time web observatory (Tinati et al. 2015)

Observatory science

Geographic Information Observatories (GIOs)

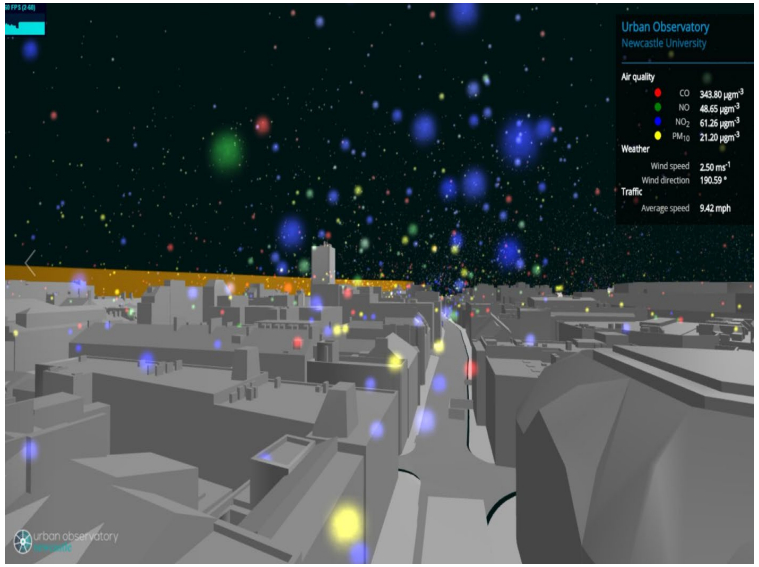
What?

Integrate the **broad geographic data** associated with a place or region

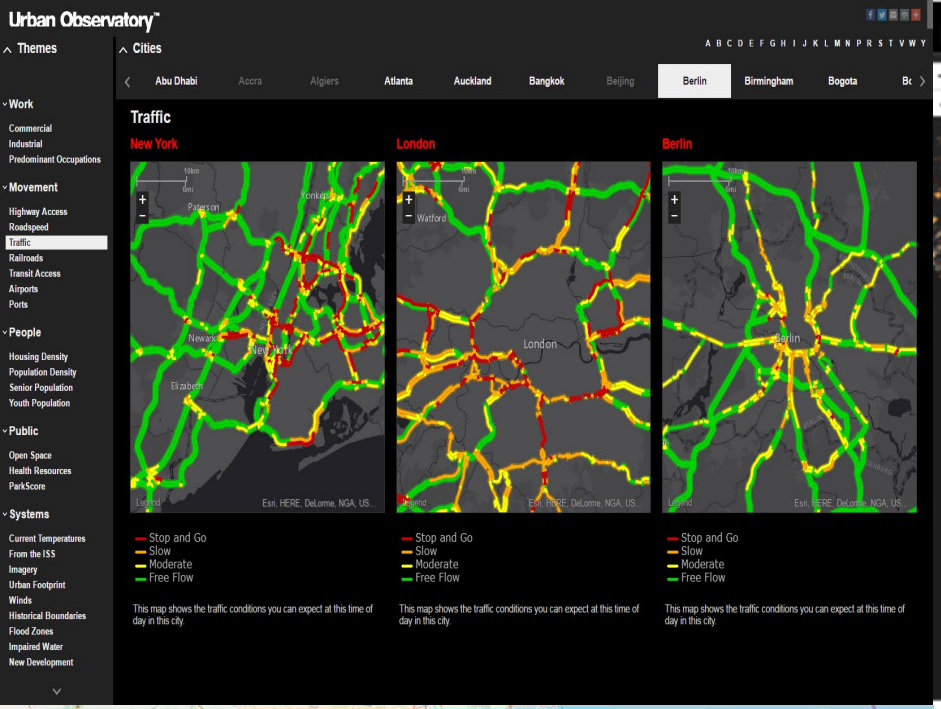
Why? Adams et al. (2014) GIO 2014: Proceedings

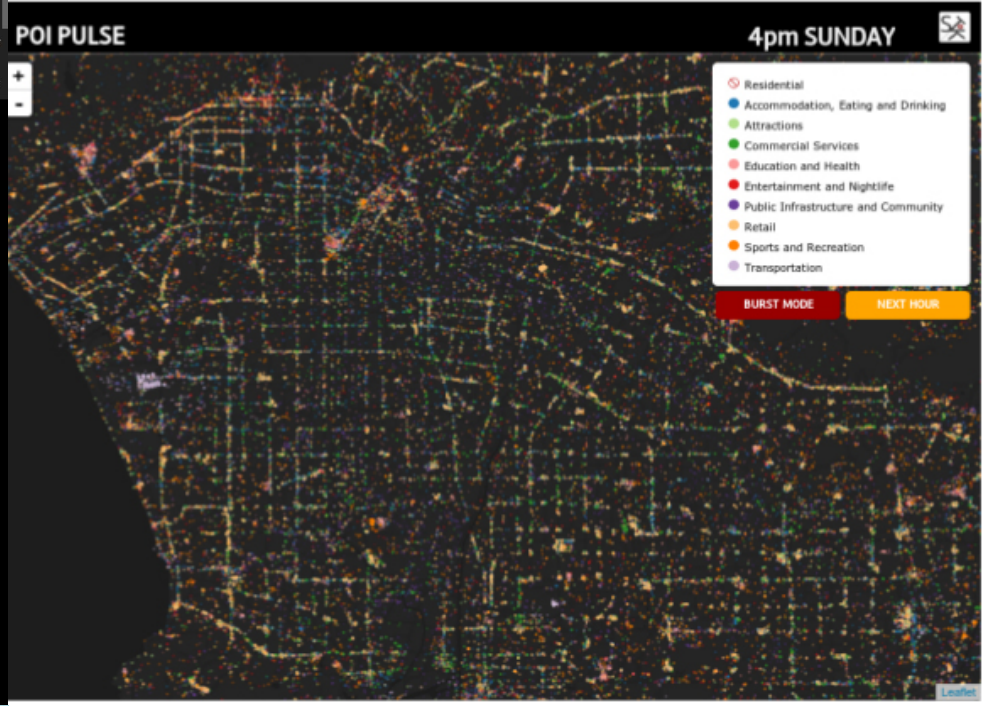
Observatory of geographic information (OGI): Understand the geographic information universe

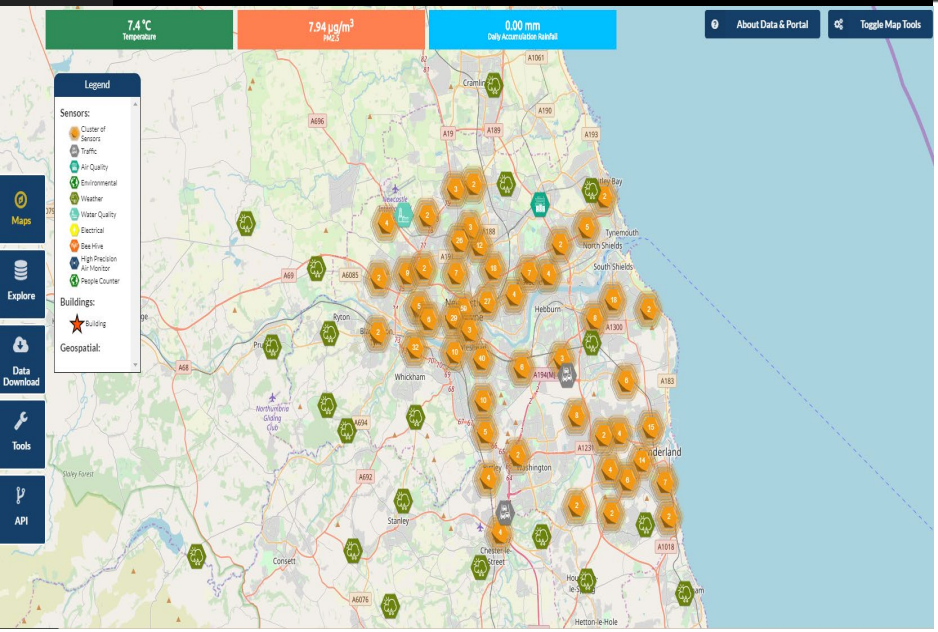
Geographic observatory (GO): Understand the real world through geographic information



http://uoweb1.ncl.ac.uk/







GIO examples

Upper left: Urban Observatory Project

Upper right: POI Pulse (McKenzie et al. 2015)

Lower left: Newcastle Urban Observatory

Opportunistic science

Data-driven knowledge discovery, construction and use that leverages planned and unplanned events in the real world

Facilitated by GIO capabilities for persistent data collection and analysis

Three facets

1. Opportunistic observation
2. Opportunistic experiments
3. Opportunistic decision-making

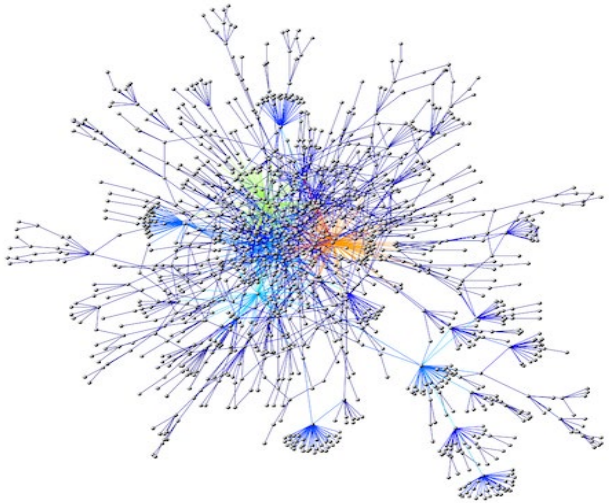
Opportunistic science

Opportunistic observation

Human and coupled human-natural systems are complex

→ Context matters!

→ History matters!



Ongoing, parallel observation is crucial

- Different geographic contexts
- Time periods sufficient to elucidate temporal dynamics
- Ready when surprises occur

Opportunistic science

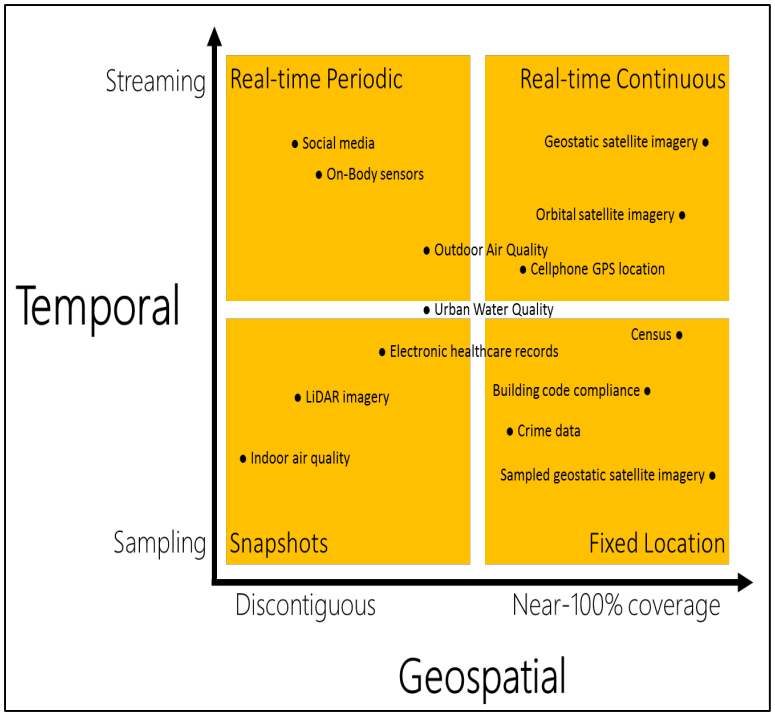
Opportunistic experiments

Leverage broad geographic data

Mundane events
Baseline measures

Unplanned events
Natural experiments

Complex policy outcomes
Non-binary outcomes
Multiple time horizons



Miller HJ and Tolle K (2016) "Big Data for healthy cities," *Built Environment,* 42, 441-456

Opportunistic science

Opportunistic decision-making

Learning from evidence can be slow with complex systems

- Despite lots of data!
- Feedback loops, delays, nonlinearities, self-organization and path dependence

www.futuretimeline.net

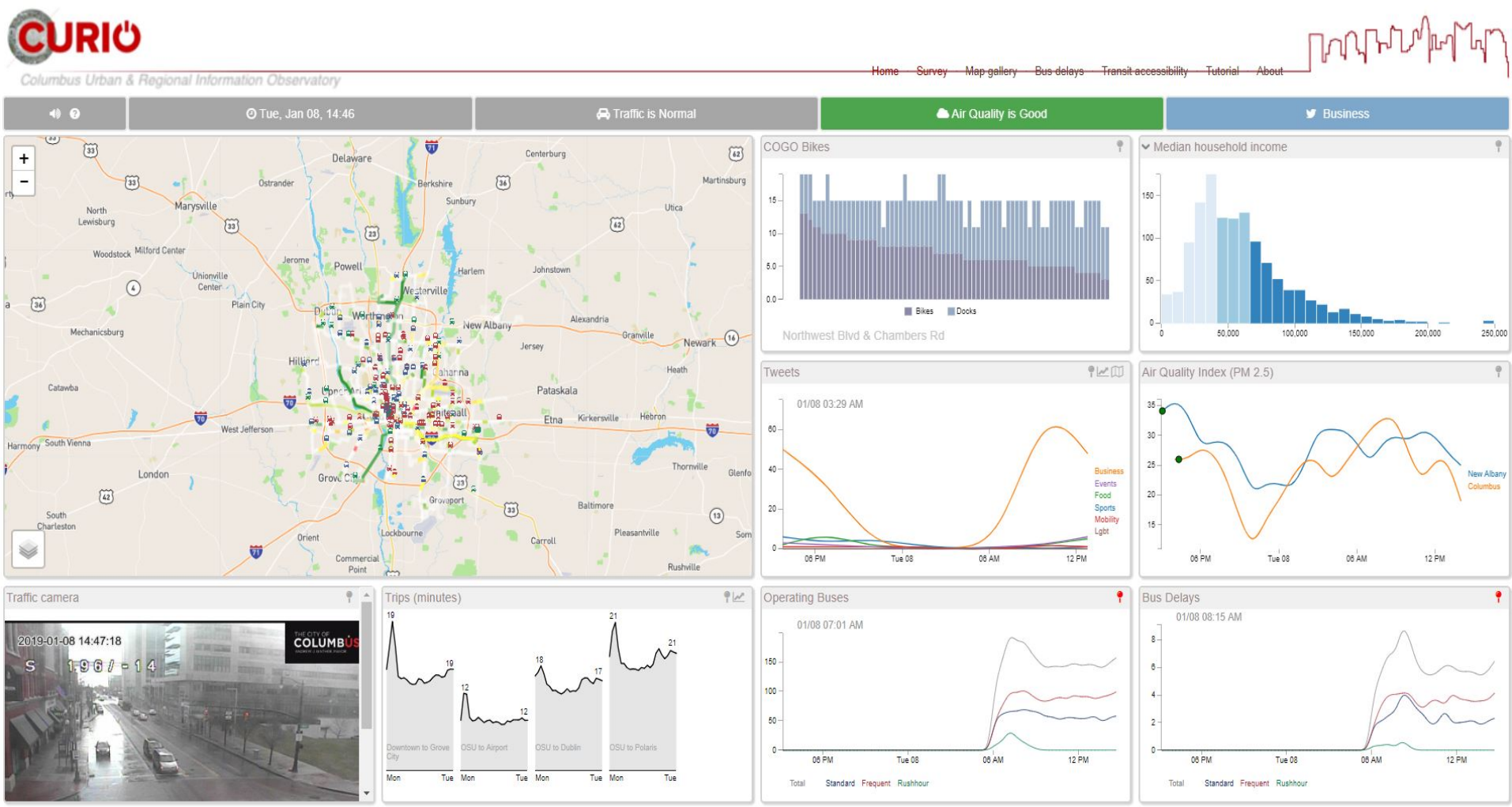
GIOs as virtual laboratories

- Agent-based modeling and geosimulation
- Integrate empirical and simulated data
- Perform experiments infeasible in the real world

Example data observatory

Columbus Urban and Regional Information Observatory (CURIO)

- A prototype/proof of concept
- Integrates publically available geographic data for Columbus Ohio
- Does not archive the data into an integrated database
- Live now at curio.osu.edu



curio.osu.edu

Next steps

- Develop and implement a system architecture for **ingesting, integrating, archiving and sharing data**
- Work with stakeholders to develop **sustainability indicators that are relevant to local goals**
- Work with potential users to develop a **flexible, interactive and map-centric sustainability dashboard**